

## Outline of TMDL modeling and data aggregation challenges

- I. Water quality criteria expressions and metrics
  - A. Spatial application
  - B. Temporal application/metrics
  - C. Natural condition provisions
  - D. 303d listing protocols and criteria metrics
- II. Modeling for TMDLs
  - A. Implementing natural condition provisions with models
  - B. Practical issues in model selection and grid setup
  - C. Steady state vs time varying simulations
  - D. Raw model output and initial processing
- III. Translating model outputs into TMDL allocations
  - A. Model output compared to criterion expression
  - B. Translating from hindcast simulations to future expectations/requirements
    - i. Natural variability, model uncertainty, and allocation expression
    - ii. Aggregation of model output over space
    - iii. Aggregation of model output over time
    - iv. Statistical analysis of output (e.g., averaging, percentiles, cumulative freq.)
  - C. Dams and temperature TMDLs
    - i. Range of potential effects of dams on travel time and temperature
    - ii. Vertical stratification in impoundments
    - iii. Persistent impacts vs transitory impacts (time lag artifacts)
    - iv. Implementation challenges